

# Clinical Outcome Metrics for Optimization of Robust Training

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# Objective



Develop and use clinical outcome metrics and training tools to quantify performance differences of physician vs. non-physician crew medical officer (CMO) analogs during simulations



# Map to the Human Research Program Integrated Research Plan



- Primary: Exploration Medical Capability (ExMC) “Risk of Unacceptable Health and Mission Outcomes Due to Limitations of In-flight Medical Capabilities”
  - *ExMC 2.02: We do not know how the inclusion of a physician crew medical officer quantitatively impacts medical risk during exploration missions.*
  - *Now Med08: We do not have quantified knowledge bases and modeling to estimate medical risk incurred on exploration missions*
- Secondary: Space Human Factors and Habitability Element (SHFE) “Risk of Performance Errors Due to Training Deficiencies”.
  - *SHFE-TRAIN-01: How can we develop objective training measures to determine operator proficiency during and after ground training?*
    - *Now TRAIN -01: We do not know which validated objective measures of operator proficiency and of training effectiveness should be used for future long-duration exploration missions.*
  - *SHFE-TRAIN-02: How do we develop training methods and tools for space medical application if time is minimal?*
    - *Now TRAIN-02: We need to identify effective methods and tools that can be used to train for long-duration, long-distance space missions.*
  - *SHFE-TRAIN-03: How can onboard training systems be designed to address Just-in-Time (JIT) and recurrent training needs for nominal and off nominal scenarios?*
    - *Now TRAIN-03: We need to develop guidelines for effective onboard training systems that provide training traditionally assumed for pre-flight.*

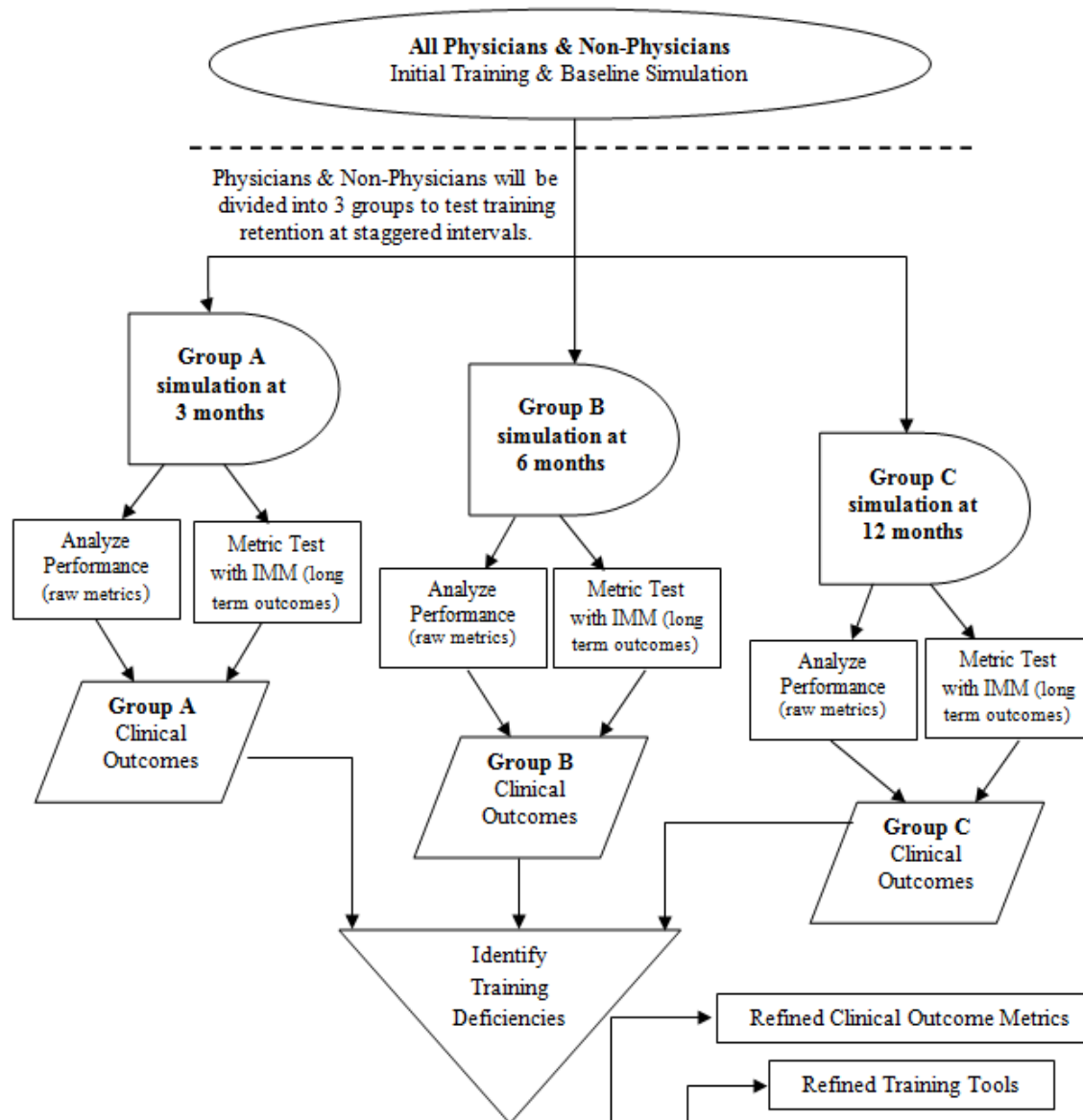


# Specific Aims



1. Develop clinical outcome metrics (immediate term) to discriminate between physician and non-physician CMO analogs.
2. Develop long-term clinical outcome metrics through modeling of mission impacts due to lack of complete clinical procedure success (Integrated Medical Model (IMM)).
3. Develop advanced training products that increase retention and reduce errors during the performance of medical procedures.
4. Promote public understanding of human research and human activity in space environments through formal and informal education opportunities.

# Experimental Design





# Fundoscopy (diagnostic) with human volunteer “patient”





# Training/Testing Modules

# Kidney/urinary ultrasound (diagnostic) with human volunteer “patient”

MENU
**COMFORT**
Baseline    Date: 10/19/2015    ID: 0003
NOTES EXIT

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KIDNEY & BLADDER
OBJECTIVE
FOUNDATION
SETUP
EXAM PROCEDURE
QUIZ
REFERENCE

Probe Handling
Concepts
Imaging
Normal Kidney
Normal Bladder
Pathology


## PROBE HANDLING: KIDNEYS

Correct probe orientation will ensure that the image is not reversed on the screen.


Position the probe with the reference marker up.

Slide away from the spine horizontally to find the right and left kidney.


Use small probe rotations and tilting to optimize the image to the longest section of the kidney.




**Left Kidney**



**Right Kidney**



**Left Kidney**



**Right Kidney**

← PREVIOUS
NEXT →



## Intubation (intervention) with simulated patient (mannequin)

**MENU**      **COMFORT**    Baseline   Date: 10/19/2015   ID: 0003   **NOTES**    EXIT


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INTUBATION   OBJECTIVE   FOUNDATION   SETUP   EXAM PROCEDURE   QUIZ   REFERENCE


Video   Step-by-step

### STEP 1: ILMA INSERTION

A neck injury is not suspected in this case, so use the head tilt chin lift method to move the tongue and jaw forward. Insert the tip of the ILMA on the roof of the mouth.



Following the natural curve of the throat, insert the LMA hugging the patient's chin with the device until it is positioned correctly.



PREVIOUS




NEXT





# Ultrasound guided intravenous access (intervention) with simulated patient (ultrasound phantom- arm)

[illegible]



# Training/Testing Modules

Differential diagnosis and treatment exercise (software-based, diagnostic positive control, physicians expected to outperform non-physicians)

MENU

COMFORT

Training

Date: 10/19/2015

ID: T002

NOTES

EXIT

DIFFERENTIAL DIAGNOSIS AND TREATMENT EXERCISE

Past Medical History

Problem Area

Vitals

Labs

Imaging

Interview

Treatment

CBC	<i>in progress</i>	<a href="#">order CBC</a>
CMP	<i>not ordered</i>	<a href="#">order CMP</a>
Liver Enzymes	<i>not ordered</i>	<a href="#">order liver enz</a>
Cardiac Enzymes	<i>not ordered</i>	<a href="#">order cardiac enz</a>
D-dimer	<i>not ordered</i>	<a href="#">order d-dimer</a>
Blood gas	<i>in progress</i>	<a href="#">order blood gas</a>
Microbiology	<i>not ordered</i>	<a href="#">order microbiology</a>
Urinalysis	<i>not ordered</i>	<a href="#">order urinalysis</a>

Select the problem area on the model below:

Right

Left

☐ Head

☐ Chest

☐ Right Arm

☐ Left Arm

☒ Abdomen

☐ Right Leg

☐ Left Leg

Was there an injury or is there pain?

☐ Injury

☒ Pain

PREVIOUS

NEXT



# Testing Procedures



- **Training**
  - Didactic and hands-on
  - Software tool used for content as well as familiarization
- **Test and re-test**
  - Autonomous
  - Access to software tool and other required resources
  - Timed
  - Live observation and metric recording
  - Software tool “click tracking”
  - Quad screen synchronized video recording



# Research Products



- Data that quantify differences in medical outcomes when physician and non-physician CMO analogs are compared in procedure simulations (immediate term outcomes) and by IMM analysis (mission impacts)
- Refined clinical outcome metrics for medical training and testing
- Innovative medical training products and solutions to maximize CMO performance
- Enhanced IMM capability through the development of algorithms that account for incorrect diagnoses and incomplete treatment
- Validation of the methods and products used by this experiment for operational use in the planning, execution, and quality assurance of the exploration mission CMO training process



# Expected Outcomes



- Do physicians perform as well as non-physicians?
- Which procedures do physicians/non-physicians perform better?
- When does training “expire”?
  - Does it differ physician vs. non-physician?
- What are the potential mission impacts?





# Status



- Procedures, metrics, and training defined
- Software ~95% complete
- Recruitment ~66% complete
  - Long wait list for non-physicians
  - Still recruiting physicians
- Testing expected to start March 2016



# SOFTWARE DEMONSTRATION





# BACK UP CHARTS



# Specific Aim 1



- **Specific Aim 1:**
  - Develop clinical outcome metrics (immediate term) to discriminate between physician and non-physician CMO analogs.
- **Research questions:**
  - What are the performance differences between physician and non-physician CMOs?
  - Do the types of errors change over time since initial training?
  - What are the best refresher training intervals for specified medical procedures?
- **Method:**
  - Evaluate physician and non-physician performance at baseline post training session, and at one retention interval (3, 6 or 12 months from their initial medical training/baseline simulation)



## Specific Aim 2



- **Specific Aim 2:**
  - Develop long-term clinical outcome metrics through modeling of mission impacts due to lack of complete clinical procedure success.
- **Research question:**
  - When mission-long impacts are considered in cases where diagnoses or interventions are not 100% correct, are the individual and mission outcomes different than when only immediate-term outcomes are considered?
- **Method:**
  - Incorporate physician and non-physician performance data into the NASA IMM to determine predicted clinical outcomes, and resource and mission impacts for specified conditions.





## Specific Aim 3 and Aim 4



- **Specific Aim 3:**
  - Develop advanced training products that increase retention and reduce errors during the performance of medical procedures.
- **Specific Aim 4:**
  - Promote public understanding of human research and human activity in space environments through formal and informal education opportunities.